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Editorial

# The changing face of vaccines and vaccination

Vaccination has made a major impact on human global health. For example, the likelihood of death from smallpox in an epidemic in the pre-vaccination era was one in two and now the associated pathogen has been eradicated, reducing the risk to zero. There are at least 31 human diseases where significant protection can be provided by currently available vaccines. A continuing driving force in the development and provision of effective vaccines stems from our increased knowledge of pathogen epidemiology, and pathophysiology and the technologies associated with the molecular sciences. Advances in our understanding of the functioning immune response have offered huge advantages in antigen selection, adjuvant formulation and delivery platforms for vaccines. Ultimately, the dividend of vaccination in preventing disease depends on the acceptance and understanding of the value brought to society. Most importantly, vaccines are part of our armoury as a species in fighting continuing and emerging pathogenic threats and this battle is rarely over. Thus the benefits depend on continuing immunisation and sufficient coverage of the populations at risk. To be optimally effective a significant majority in society must receive vaccination and this can be undermined by the actions of vocal anti-vaccine minorities. It is vital that vaccine safety and effectiveness are transparently and frequently reviewed; this is necessary in order to maintain the trust and endorsement of approval by the general public.

There are many factors that contribute to developing and delivering a vaccine and vaccination programme that can provide optimal protection of at risk populations. The goal of this special issue of Vaccine is to provide a cutting edge, comprehensive and integrated perspective of the key areas from the early development of a vaccine concept to delivery of health impact. The collection of articles is aimed at interested research scientists and clinicians but also the wider community of relevant health care professionals. The articles use specific examples of pathogens/vaccines to illustrate the principles of development, provision including for special populations, safety, strategies, hesitancy and impact.

The first article, *Vaccine Development: From concept to early clinical testing* [1], covers the requirement for a detailed knowledge of the pathogen as a pre-requisite for antigen selection. It describes how disease epidemiology and clinical manifestations influence vaccine requirements. Examples of how our increasing knowledge and new technologies can drive innovative vaccine design are provided. Finally how the manufacture and delivery of vaccine antigens is practicably achieved is briefly described.

The next article, *Vaccine Provision: Delivering sustained & widespread use* [2], describes the need for extensive quality control measures to assess vaccine safety, potency and purity. Thus a large proportion of vaccine development time is dedicated to such quality control activities and accounts for why vaccines can take decades to develop and months to produce, once approved. The potential to expedite procedures in the face of an emergency such as a pandemic are described. Issues such as the design of vaccine delivery vehicles and shelf life are important. Thus single-dose vials avoid preservatives but can significantly impact on supply and cost. The fact that most vaccines require strict temperature control (cold chain) also generates logistical challenges for supply and potency.

The preeminent importance of safety is underlined in *Vaccine safety evaluation: practical aspects in assessing benefits and risks* [3]. Thus vaccine safety is assessed from inception through its entire duration of use. A vaccine's safety profile is continuously updated based on continuing surveillance. When needed, actions are taken and communicated rapidly to the community. Monitoring vaccine safety is a shared responsibility and healthcare providers are encouraged to report all adverse events after vaccination, for assessment of the cause. Verification of causality is critical to maintaining public confidence in vaccines.

The ability to protect the most vulnerable in society through vaccination is dealt in *Vaccination of special populations: Protecting the vulnerable* [4]. Examples are given of various special groups that are at increased risk of vaccine-preventable diseases and how vaccination strategies are put in place to address their disease risk. The issues surrounding the facts that preterm infants and pregnant women often do not receive recommended vaccines and people with chronic medical conditions or who are immune-compromised due to disease or aging are under-vaccinated are discussed. Ultimately, national recommendation on vaccination needs to be delivered by health providers to maximise benefits.

In this context, *Vaccines Strategies: Optimizing outcomes* [5], reviews the many components that must come together for delivery of effective immunization services. This is more difficult in less developed countries that may lack the appropriate healthcare infrastructure. Issues covering the need for any vaccination strategy to be feasible and acceptable to the target population and how experience and research illustrate which vaccine strategies work well are described. Thus tailored, culturally appropriate local approaches usually encourage success.

There are increasing problems with vaccine hesitancy and this provides a major threat to the continued prevention of known human disease and the emerging threats for evolving or new pathogenic threats. One key area likely to be impactful in defeating this threat is the pivotal importance of healthcare providers in reassuring and educating the general public and this is covered in *Vaccine hesitancy and healthcare providers* [6].

Finally, *Vaccine Impact: Benefits for human health* [7], reviews the broad impact of vaccines on health extending beyond the vaccinated individual. Thus vaccines can positively impact health,

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cognitive development and productivity. Continuing and broader success requires delivering vaccine coverage sufficient to interrupt transmission. It is important to note that vaccination can modify disease epidemiology and that this will require changes in vaccine strategies. Ultimately, ensuring the continued success of vaccination is a shared responsibility of all aspects of the global community.

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